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DISCUSSION PAPER SERIES

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ABSTRACT

Saving Neonatal Lives for a Quarter*

Over 400,000 children die annually from neonatal sepsis, despite several RCTs finding that this can be prevented by chlorhexidine cord care (CHX) for only US$0.23 per dose. Unresolved heterogeneity in findings and other RCT scalability concerns contribute to slow CHX adoption. Studying the first national CHX roll-out — in Nepal — we find that CHX reduces neonatal mortality by 56 percent for births predicted to take place at home. We find no effect for predicted health facility births, which is consistent with heterogeneity in prior experimental estimates. Conditional on predicted place of delivery, there is little significant treatment effect heterogeneity.

JEL Classification: I18, J13, O15
Keywords: neonatal mortality, chlorhexidine, Nepal

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1 Introduction

Randomized controlled trials (RCTs) play an increasingly important role in policy making in developing countries. The body of experimental evidence may however appear contradictory, and critiques have pointed to context-dependence as a key weakness of field experiments (Pritchett and Sandefur, 2015; Al-Ubaydli et al., 2017; Deaton and Cartwright, 2018). A second criticism contributing to the alleged weak external validity of field experiments is that the strict implementation of the experimental protocol in well-run RCTs cannot be replicated in "real-world" conditions, leading to disappointing effects at scale. While meta-analysis methods are of great value (see Meager, 2019; Vivalt, forthcoming, and references therein), they get around the first but not the second of the above criticisms against the scalability of RCTs. To address the skeptics' "real-world" criticism, RCTs need to be complemented with convincing non-experimental evidence.

In this paper, we present new quasi-experimental evidence on the effectiveness of an inexpensive solution to neonatal sepsis — a condition which is estimated to kill 401,000 newborns each year — for which the body of experimental evidence is mixed: chlorhexidine (CHX) cord care. Our results (i) show that large reductions in neonatal mortality (NMR) can be achieved through CHX at scale outside ideal experimental conditions and (ii) strongly suggest that the contradictory results in the prior experimental literature are consistent with the powerful mediating role of place of delivery (home vs. facility).

Each year, it is estimated that as many as 1.7 Million newborns die within the first 28 days of their lives, including an estimated 401,000 due to bacterial infection in the blood ("neonatal sepsis") often caused by infection of the umbilical cord or omphalitis (Liu et al., 2016). The application of a commonly used disinfectant, CHX, to the umbilical cord — costing only US$0.23 per dose — was hailed a "game changer" that may nearly eradicate neonatal sepsis following three RCTs finding that CHX decreased the neonatal mortality rate (NMR) by between 20 and 38 percent (Mullany et al., 2006; El Arifeen et al., 2012; Soofi et al., 2012; Hodgins et al., 2013). Yet — considering the large experimental benefits observed in these initial trials, the low cost involved, and World Health Organization recommenda-

tions — expansion has been slow.[1]

An important factor in this slow rate of adoption is failed replication in two further RCTs, which led experts to express doubt about the effectiveness of CHX application at scale (Semrau et al., 2016; Sazawal et al., 2016; Osrin and Colbourn, 2016; Ponce Hardy, 2018). Explaining the heterogeneity of findings across RCTs is complicated by the small number of available studies, unavailability of the microdata produced by the trials, and the high correlation between potential sources of heterogeneous treatment effects across study sites, since the first three successful RCTs took place in South Asia (Bangladesh, Nepal and Pakistan) and the two unsuccessful RCTs took place in Southeast Africa (Tanzania and Zambia).

The first country to introduce CHX cord cleansing nationwide is Nepal. We exploit plausibly exogenous variation in the timing of the CHX cord care program expansion across districts of Nepal in a difference-in-differences approach using data from the nationally representative 2016 Nepal Demographic and Health Survey (DHS). After piloting the program in 4 out of 75 districts from late 2009, CHX cord application was quickly scaled-up across the rest of the country (see Figure 1). By 2015, 75 percent of the population was covered by the program (Department of Health Services, 2015). While the Chlorhexidine Navi(Cord) Care Program (CHX-NCP) was integrated to the training, monitoring systems and operations of national newborn health programs (primarily "Community-Based Newborn Care Program" or CB-NCP), the exact timing at which CHX-NCP was rolled out to a particular district largely depended on practical considerations such as presence of implementation partners on the ground and district government leadership.[2]

[Figure 1 about here.]

We estimate that, overall, the CHX program decreased neonatal mortality by 1.8 percentage points or 43 percent compared to the control group mean. This was

[1] Following these first three RCTs, from 2013 the WHO started recommending the application of CHX for home births in settings with neonatal mortality above 30 per 1000 (World Health Organization, 2015). CHX is currently at various stages of implementation in 11 countries (Bangladesh, the Democratic Republic of the Congo, Ethiopia, Kenya, Liberia, Madagascar, Malawi, Mozambique, Nigeria, Pakistan and Sierra Leone) and under consideration in several others (PATH, 2017).

[2] Implementation partners were Care Nepal, Save the Children, Health Right International, UNICEF, ADRA and One Heart Worldwide (JSI Research & Training Institute, 2017).

driven by a 56 percent decrease among births predicted to take place at home, while the estimated effect is both very small in magnitude and statistically insignificant among babies predicted to have been delivered in health facilities. The difference in treatment effect between the two groups defined by predicted place of birth is statistically significant (p-value: 0.031).

Place of delivery is only collected for births in the five years preceding the survey. In this sample, 41 percent of births occur at home, and the CHX program has no effect on whether the birth occurred at home, as would be expected since the program targeted all births irrespective of place of delivery. In order to use data covering a longer period of time and thus increase power, we predict whether a child was delivered at home as a function of observable characteristics — and correct standard errors for the uncertainty due to predicting- rather than observing place of birth accordingly. In the sample for which we know the place of delivery, the model predicts place of birth correctly in 76 percent of cases.

Our conclusions are robust to a comprehensive number of robustness checks. In particular, we find that a placebo treatment "switching on" 12 months before the actual roll-out of CHX-NCP in the district has no effect, that the CHX-NCP treatment is not associated with a decrease in mortality between 2 and 12 months after birth, and that estimates based on within-mother variation in treatment exposure are very similar to estimates exploiting within-district variation. These checks narrow down the possibility of omitted variable bias to variables that would decrease neonatal mortality but not mortality after this short period of vulnerability to omphalitis *and* which would affect neonatal mortality at the time of CHX roll out but not shortly before that. Finally, we show that it is highly unlikely that our conclusions are affected by treatment effect heterogeneity within the context of our two-way fixed effects model.

Our results show that children only benefit from CHX application if they are predicted to be born at home, in line with WHO recommended use. An important advantage of targeting births by place of delivery is the ease with which targeting can be effected. We go further and test whether it would be possible to improve targeting if some basic information about the mother and child were available to health practitioners. Interestingly, after targeting by predicted place of delivery, most indi-

vidual socio-economic and demographic characteristics do not significantly interact with CHX treatment. An exception is very young maternal age: while this sample is small, among children of mothers below age 17, CHX appears extremely beneficial even among predicted facility births.

We make two contributions to the literature. Our first contribution is to estimate the effectiveness of CHX cord care on NMR outside an experimental setting. Concerns about the scalability of experimental findings are well-known, and typically emphasize factors which lead to *smaller* treatment effects at scale — such as false positives, selected and non-representative samples, high compliance and adherence to protocol which cannot be replicated in "real-world" conditions (Al-Ubaydli et al., 2017). But in the case of CHX cord care, the treatment effect might in fact be muted in ethical clinical trials because, upon participation in the trial, the probability of death is reduced for two reasons.[3] First, newborns involved in these trials are referred to the hospital if signs of cord infection (omphalitis) appear during the frequent research team visits. CHX is expected to prevent neonatal mortality by reducing the incidence of omphalitis. Hence a reduction, or even suppression of neonatal mortality due to omphalitis — thanks to early detection and medical referral — would lead to underestimation of the effect of CHX application on NMR in the trial.[4] Second, there is no pure control group: both treated and control groups typically receive a comprehensive package of measures preventing omphalitis, which reduces the relevance of CHX application (Semrau et al., 2016) and go well beyond the usual standard of care in low-income settings.[5] Indeed, in both unsuccessful trials, the authors note that NMR was between 32 percent and 40

[3]Lund et al. (2014) find evidence of a distinct- but related issue in drugs RCTs. In these RCTs, treatment effects are obtained by comparing the drugs arm not with a pure control but with a placebo arm, which underestimates the drugs treatment effect if (i) the placebo and drugs effects work through different channels or (ii) there are ceiling effects putting an upward limit on the total treatment effect.

[4]Another potential channel through which CHX cord care may prevent neonatal death is by preventing neonatal tetanus (Bennett et al., 1997). In the Nepal CHX trial, this potential pathway to impact was also shut down by ensuring full maternal tetanus immunization at enrolment in the trial (Mullany et al., 2006).

[5]The typical package of services received by both control and treated subjects in CHX application trials are: a clean delivery kit, referral to clinic in the presence of danger signs, newborn health messages, antenatal clinic visits, and home visits starting soon after birth.

percent lower than in the most recent Demographic and Health Survey for the relevant area — even in the control group. And in one of the two unsuccessful trials, CHX application was found to be effective in reducing omphalitis, but not NMR (namely in Sazawal et al., 2016), as would be expected if clinic referrals following early signs of omphalitis succeeded in preventing death.

Our second contribution is to compare, in real-life conditions, the effectiveness of CHX cord care for babies delivered at home vs. babies delivered in a health facility — an essential question in terms of policy targeting. Meta-analyses of existing clinical trials have concluded that CHX cord care was only effective for home deliveries, which is not surprising given that 90% or more of the births included in the South Asian trials took place at home vs between 36% and 47% in the Southeast African trials (Imdad et al., 2013; Sankar et al., 2016; López-Medina et al., 2019). But these meta-analyses have important limitations due to the small number of included studies and the possibility that heterogeneous results by place of birth may be confounded by other differences across studies — such as the number of CHX applications or factors correlated with economic development or cultural practices.[6] The additional evidence we provide is therefore needed to assess the impact of the WHO recommendation to limit CHX cord care to babies delivered at home.

Despite there being readily available medical solutions to prevent most of today's neonatal deaths (Bhutta et al., 2014), there is a large gap between recommended- and actual practice in many dimensions of newborn care (Friberg et al., 2010; Requejo et al., 2015). And scaling-up interventions shown to work in trials often leads to disappointing results (Shankar et al., 2008; Kishwar et al., 2010) — illustrating the "scalability" problem potentially present in small-scale experiments (Al-Ubaydli et al., 2017). Prior work studying the effect of health programs carried out at scale in developing countries has indeed found at best small decreases (<0.3 percentage points) in neonatal mortality (Lim et al., 2010; McK-

[6] As suggested by Vivalt (forthcoming), modelling heterogeneity in the microdata might in part circumvent the small number of studies, but RCT microdata is often unavailable (as is the case for the CHX trials mentioned here). Even if these were available, with over 90% of births occurring at home in the three South Asian trials, it would be difficult to disentangle the mediating effect of place of delivery from a range of context-specific variables such as typical cord care and hygiene practices.

innon et al., 2015; Powell-Jackson et al., 2015; Arulampalam et al., 2017; Van de Poel et al., 2016; Philibert et al., 2017; Fitzpatrick, 2018). Broad-based National Health Insurance systems introduced in the last few decades in a number of middle-income countries have been found to reduce infant mortality (see Conti and Ginja, forthcoming, and references therein), but the few estimates on neonatal mortality are mixed (Bhalotra et al., 2019).[7,8] Among the few studies estimating the effect of health policies in today's developed countries in a historical context, Lazuka (2018) find that delivery and newborn care by qualified midwives prior to 1930 in Sweden led to an estimated 49-61 percent reduction in NMR and Fung and Robles (2016) estimates that antenatal syphilis testing initiated in 1938-1947 in the US reduced NMR by 8.6 percent among non-Whites. Other related large-scale health interventions such as increasing contraceptive supply or improving access to abortion do not appear to reduce neonatal mortality (LeGrand and Phillips, 1996; Miller, 2010; Valente, 2014).

Many low-income countries today are not yet able to afford broad-based universal health insurance. In this context, the existing literature offers few options to health policy makers looking for evidence-based, affordable at-scale solutions to reduce neonatal mortality in low-income settings. In this paper, we show that the application to the cord of a single dose of CHX at birth is one such option. While the incidence of home deliveries is decreasing, many lives could be saved by applying CHX to the cord — especially in the context of the COVID-19 pandemic, which threatens both current access to health facilities and future maternity care funding (Puri and Stone, 2020; Health Policy Plus, 2020; UNFPA, 2020).

The rest of the paper is organized as follows. In Section 2, we give an overview of early life mortality trends and CHX cord care in Nepal. Section 3 presents the data and identification strategy. The main results and robustness checks are reported in Section 4. Section 5 further explores heterogeneity in the effect of CHX application and draws lessons for targeting. Section 6 concludes.

[7] PROGRESA, which paid cash transfers conditional to poor households conditional on, among others, regular prenatal checks, has been found to significantly decrease infant mortality, but not neonatal mortality (Barham, 2011).

[8] Historical evidence from today's developed countries has concentrated on infant mortality (see, e.g., Bauernschuster et al., 2017, and references therein).

2 Background

2.1 Early Life Mortality in Nepal

Nepal is a landlocked country situated between China and India which is home to 28.1 Million people. The country's Human Development Index ranks only 147 out of 189 (in 2019) and more than a third (36 percent) of children under age 5 are stunted. Notably, Nepal has seen sharp decreases in fertility over the past twenty years — from 4.6 children per woman in 1995 to 2.3 in 2016, and marked reductions in child mortality — from 118 deaths before the age of 5 per 1,000 births in 1992-1996 to 39 in 2012-2016.

However, progress in the NMR reduction in Nepal stalled in the early 2000s (at 33 per 1,000 both during 2002-2006 and 2007-2011) while under-5 mortality slowed down its downward trend, going from 61 to 54 per 1,000 during the same period.[9] This stagnation came to an end in 2012-2016 as NMR dropped to 21 per 1,000 — a 36 percent decline relative to the previous 10-year period.

2.2 Chlorhexidine Cord Care

The latest decrease in NMR observed since 2012 coincides with the acceleration of the roll-out of CHX cord application through the Chlorhexidine Navi(Cord) Care Program (CHX-NCP) (see Figure 2).

CHX-NCP was a $3.9 million program funded mainly by bilateral donors (US, Norway, Canada, UK) and the Bill & Melinda Gates Foundation. In partnership with the Nepalese Department of Health Services, international NGOs and a Nepalese pharmaceutical company which produced the CHX gel locally, the program was implemented by JSI Research & Training Institute, Inc. and was designed to support the Government of Nepal to scale up the use of CHX for cord care nationwide. This involved training as well as procurement, logistical, monitoring and technical support.

[Figure 2 about here.]

[9] All the mortality and fertility figures in this sub-section are taken from Ministry of Health, Nepal and New ERA and ICF (2017).

The scaled-up intervention consisted of a single CHX gel application on the day of birth to all newborns irrespective of place of birth. For home births, CHX gel doses were distributed to pregnant women during antenatal care visits in the last two months of pregnancy (Hodgins et al., 2019).[10,11] The CHX training of health workers lasted between three hours and one day and to reduce costs and increase program sustainability, training and monitoring activities were integrated into broader maternal and newborn health programs, and in particular into the Community-Based Newborn Care Program (CB-NCP) (JSI Research & Training Institute, 2017; JSI, 2017; Hodgins et al., 2019).

Estimates of actual CHX application in program districts vary much and, for home deliveries, an important limitation is that there is no record of application and that maternal recall is unlikely to be reliable for non-salient events (Beckett et al., 2001).[12] Coverage estimates suggest that it may have peaked in 2014/2015, as estimates range from 75 percent of home deliveries and 96 percent of facility deliveries (HIMS (2014), as cited in Khanal (2015)) to 75 percent of all births according to Department of Health Services (2015) to only about 40 percent of home births and 90 percent of facility births in 2017 according to Hodgins et al. (2019) so that estimates presented in this study should be interpreted as intention-to-treat effects — arguably the parameter of interest from a policy point of view. The coverage is however consistently estimated to be higher among health facility deliveries, so that heterogeneity in treatment intensity cannot account for the larger decrease in NMR observed among predicted home births.

[10]Eighty four percent of women who gave birth in the five years leading to the 2016 DHS received antenatal care and 69 percent received four antenatal care visits or more (Ministry of Health, Nepal and New ERA and ICF, 2017).

[11]Table A.1, Panels B and C report results obtained when estimating our difference-in-differences equation using, in turn, the number of antenatal visits or an indicator for having an above-median number of antenatal visits as dependent variable, which show that CHX-NCP was not accompanied by an increase (or decrease) in the number of antenatal care visits.

[12]In the DHS, women who gave birth within five years of the interview are asked, among many other things, whether anything was placed on the stump after the umbilical cord was cut, and if so, what substance was applied. There is good reason to think that answers to these questions are not reliable: While CHX was neither available nor promoted in a district prior to the roll-out of CHX-NCP, as many as 16 percent report that CHX was applied to the stump of the newborn in *untreated* district-by-time cells. Meanwhile only 31 percent report that CHX was applied to the stump of the newborn in *treated* district-by-time cells.

3 Data and Identification Strategy

3.1 Data

The 2016 Demographic and Health Survey (DHS) of Nepal is a nationally representative survey that collected detailed pregnancy histories of all women age 15-49 found in sampled households, as well as comprehensive data on the demographic and socioeconomic characteristics of the household and its members. The dataset includes, for each child ever born to the interviewed women, dates (month and year) of birth and death, if applicable. Detailed information on antenatal and postnatal care is also collected for births occurring within 5 years of the interview, including place of delivery.

In the absence of comprehensive vital statistics systems, the DHS is the main source of information on child mortality in Nepal as in many other developing countries.

The survey collected data on a total of 26,028 births. We drop 366 multiple births, 118 births to mothers who are either less than 15 or 45 and above and 118 births occurring within one month of the interview date and thus not fully exposed to the risk of neonatal death. While recall error is unlikely to be an issue for such a salient event in the life of a woman as the death of a newborn, we restrict our main analytical sample to births that occurred within 25 years prior to the date of interview, resulting in a sample of 23,465 births. Robustness checks varying this time window by 5 years on either side show that our findings are not sensitive to this sample selection criteria (see Section 4.2).

We merge the DHS microdata with administrative data on the implementation of all the main programs targeting maternal and newborn health in Nepal which were not available in all districts of Nepal by 2009 when CHX-NCP was first piloted. It is to be expected that in any non-experimental setting, a number of initiatives from national authorities and international organizations are ongoing at any one time. To ensure that we captured the effect of CHX-NCP independently of any other intervention, a thorough identification of programs that may have contributed to recent decreases in NMR was done by the Kathmandu-based Center for Research on Environment, Health and Population Activities (CREHPA) in two steps. First,

all annual reports produced by the Department of Health since 2013 were analyzed in detail to identify candidate explanations for the recent decrease in NMR. Second, semi-structured interviews with 12 in-country neonatal and maternal health experts — from, among others, the Family Welfare Division of the Department of Health Services, the WHO, UNICEF, and Children and Maternity hospitals — were carried out in order to collect their specialist views on the most likely reason(s) for the NMR reduction.[13] Dates of the district-level roll-out of each program were then collected from various Department of Health Annual Reports, and controls included in the main analysis for the two health programs targeting newborns specifically (CB-NCP and CB-IMNCI) and in robustness checks for secondary programs whose coverage is not fully captured by time fixed-effects. For CHX-NCP, which was administered by JSI, we obtained roll-out dates from the CHX-NCP program director.

In Table 1, we report summary statistics for the whole sample and separately for children predicted to be born at home or not to be born at home using the approach described in Section 3.2. These statistics highlight that the sample at hand has very low levels of human development, with 57 percent of children having mothers with no formal education, 41 percent living in rural areas, and one in five children being born to a teenage mother. Forty-eight percent of children are female, which is close to what would be expected given the widely observed natural sex ratio at birth (51 percent male).

[Table 1 about here.]

3.2 Identification Strategy

In our main specification, we estimate linear probability models of the form:

$$m_{idt} = \alpha + \beta CHX_{dt} + D_d'\Delta + T_t'\Gamma + X_{idt}'\Lambda + \varepsilon_{idt} \quad (1)$$

where m_{idt} is an indicator equal to 1 if child i dies by age one month (allowing for "heaping" at one month) and zero otherwise, CHX_{dt} is an indicator equal to 1 if CHX-NCP was rolled out in the child's district by the date the child was born, D_d

[13] Ten interventions were identified by key informants, including CHX-NCP.

is a vector of district fixed effects, T_t is a vector of time fixed effects, where time is defined at the month-by-year level (e.g., Ashwin 2066 in the Nepali calendar or October 2009), X_{idt} is a vector of controls comprising child, mother, household characteristics and district-time varying controls such as exposure to health programs other than CHX-NCP; $\alpha, \beta, \Delta, \Gamma$ and Λ are parameters to be estimated; and ε_{idt} is an error term allowing for arbitrary intra-district correlation.

The WHO guidelines recommend the application of CHX to the cord only for home births in settings with neonatal mortality above 30 per 1000. To shed light on the appropriateness of the distinction made by the WHO between home- and facility deliveries, we allow for heterogeneous treatment effects across predicted home deliveries and predicted facility deliveries.

Place of delivery is only collected by the DHS for births in the five years leading to the survey. In order to use data covering a longer period of time and thus increase statistical power, we predict whether a child was delivered at home using a linear probability model regressing an indicator for being delivered at home on birth order, maternal age group, child gender, maternal ethnicity, altitude quintile, maternal education, rural location, wealth quintile, district fixed effects and date of birth — defined by Nepali month and year of birth — fixed effects (see Table A.2).

In the sample for which we know the place of delivery, when predicting a home birth based on a probability of home delivery above 0.5 predicts place of birth correctly in 76 percent of cases (see Appendix Figure A.1). In order to account for the uncertainty in classifying births based on their predicted- rather than observed place of delivery, we obtain bootstrapped standard errors — clustered at the district level — by drawing 200 random samples from the original dataset, and, for each random sample, predicting whether the baby is delivered at home or not and then re-estimating the relevant variant of Equation (1).

Since we control for time- and district fixed effects, identification relies on the absence of time-varying omitted factors correlated with the timing of treatment. Regressing the treatment indicator on observable characteristics, we find that, other than the expected positive correlation between CHX-NCP and CB-NCP, the program on which CHX-NCP "piggy-backed" (Hodgins et al., 2019), the treatment

is only weakly correlated with observable characteristics.[14] Among the sample of births predicted to take place in an institution, treated babies are significantly less likely to be found in rural areas, to be their mother's third born and more likely to have a mother with an ethnicity from the residual "other" group. Among the sample of births predicted to take place at home, babies born after CHX was introduced in their district are slightly — up to 1.6 percentage points — less likely to be born to a mother with a secondary degree and more likely to have a mother from the second wealth quintile. However, these differences are small, there is no clear pattern of selection in terms of socio-economic status and, in the case of predicted home births, only statistically significant at the 10 percent level (See Figure 3 and Appendix Table A.3). In Section 4.2, we report on a number of robustness checks which indicate that our findings are unlikely to be biased by a correlation between district trends in early life health and the timing of CHX-NCP rollout.

[Figure 3 about here.]

Recent work has shown that, in the presence of heterogeneous treatment effects, two-way fixed effects models such as the one we estimate can significantly depart from the average treatment effect (e.g., Goodman-Bacon, 2018; de Chaisemartin and d'Haultfoeuille, 2020). Checks reported in Section 4.2 suggest that our results are not driven by weighting issues in the two-way fixed effects model.

4 Results

4.1 Main Results

Table 2 reports our baseline estimates. In Column (1), we estimate Equation 1 on the full sample and find that CHX-NCP decreases neonatal mortality by 1.8 percentage points or 43 percent of the control mean. In Column (2), we allow the effect of CHX-NCP to vary by predicted place of birth by including a control for

[14] Paudel et al. (2017) use difference-in-differences in a matched district sample to evaluate the impact of the CB-NCP pilot on a range of antenatal and postnatal care variables and find no effect.

predicted place of birth (1[P(home birth)>0.5]) and an interaction between predicted home birth and the CHX-NCP treatment variable. In this specification, the treatment effect is not significant for predicted facility deliveries but it is four times larger (2.8 percentage point) and statistically significant among predicted home deliveries. Finally, in Columns (3) and (4) we allow all the model coefficients to vary by predicted place of birth, which leads to a near-zero estimated effect of CHX-NCP among predicted facility deliveries (0.1 percentage point) while the estimated decrease in the probability of neonatal mortality among predicted home deliveries remains equal to 2.8 percentage points — and we can reject the null of no difference in treatment effect between the two samples defined by predicted place of delivery (p-value: 0.031).

[Table 2 about here.]

CHX-NCP covered both home- and facility deliveries and therefore it did not create an incentive for mothers to deliver at home rather than in a facility or vice-versa in order to obtain a CHX dose. For the subsample for which we know the place of birth, we can test whether CHX-NCP had an effect on place of birth. Table A.1, Panel A reports results obtained when estimating Equation (1) using an indicator for home delivery as dependent variable, which show that CHX-NCP did not change the probability of a home delivery.

4.2 Robustness Checks

We start by addressing the question of whether our treatment effect captures unobserved time-varying factors associated with a decrease in NMR in treated districts relative to control districts. To do so, we carry out three checks which bolster our confidence in the causal interpretation of our results.

First we define a placebo treatment which is equal to one if the child was born 12 months before the CHX-NCP was rolled out in the district or later, and zero if the index child was born earlier. In Column (1) of Table 3, we show that including this variable in our main specification has no effect on our estimated treatment effect, and that the coefficient associated with the placebo treatment variable is very close

to zero (0.001) and statistically insignificant.[15]

[Table 3 about here.]

Second, we re-estimate Equation 1 using mother fixed-effects instead of district fixed effects and find similar results (Table 3 Column (2)). This indicates that our district fixed-effects estimates are not biased by differential changes in the composition of mothers between treated and control districts (e.g., due to differential trends in maternal education or living standards between maternal cohorts).

Third, we carry out a falsification test based on the fact that omphalitis primarily affects neonates, but is uncommon among older infants (Painter and Feldman, 2019). CHX application, which narrowly targets omphalitis, should therefore decrease neonatal mortality but not mortality between 2 and 12 months of age — whereas unobserved time-varying improvements in maternal and child health should decrease both. In Column (3) of Table 3, we estimate Equation 1 using as dependent variable an indicator equal to 1 if the child died between 2 and 12 months of age and zero if they survived beyond infancy — the 12 first months of life — and find that babies born under the CHX-NCP program were *more* likely to die between 2 and 12 months. This is both interesting and unsurprising: risk factors for the development of omphalitis include a number of risk factors for post-neonatal infant mortality such as low birth weight and unhygienic practices (Painter and Feldman, 2019) so that the babies who survive the neonatal period due to CHX are "negatively selected" — i.e., disproportionately likely to die later in infancy. Reassuringly, the total effect of CHX-NCP on overall mortality in the first year of life is however a statistically insignificant but large in magnitude *decrease* in infant mortality (by 1.6 percentage points).

Given the small sample sizes we have in our data at the monthly level — the level at which treatment is defined, an event-study analysis leads to very imprecise

[15] If instead we keep only pre-treatment observations and estimate Equation 1 replacing CHX_{dt} with the placebo treatment CHX_{dt-12}, we also find that the placebo treatment effect is close to zero (0.003) and statistically insignificant (Table A.5), whereas if we estimate Equation 1 in a sample including only untreated children and children born no more than 12 months after the roll-out of CHX-NCP in their district, the effect of CHX-NCP is close to our main estimate (-0.027) and statistically significant at the 5 percent level (Table A.6).

estimates. For completeness, we report the estimates obtained from an event-study analysis at the quarterly level (Figure 4), which show a noisy but largely flat and non-negative pattern prior to the introduction of the CHX program in the district, and then increasingly negative treatment effects after the program is rolled out. Similarly, we lack statistical power if restricting the sample to recent births, for which we know the place of delivery — especially when splitting the sample by place of birth rather than using the whole sample and interacting place of birth only with CHX-NCP. Results are however qualitatively similar. First, the treatment effect obtained on this sample, while statistically insignificant, corresponds to a reduction of 29- to 39 percent of the control mean among home births (Columns (4) and (2) respectively, Table A.7). Second, no reduction in the probability of neonatal mortality is observed for babies delivered in a facility and third, the difference between the treatment effects for home- and facility births is statistically significant.

[Figure 4 about here.]

Recent work has shown that, in the presence of heterogeneous treatment effects, two-way fixed effects models such as the one we estimate can significantly depart from the average treatment effect (e.g., Goodman-Bacon, 2018; de Chaisemartin and d'Haultfoeuille, 2020).[16] Of particular concern is the fact that some of the treatment effects averaged over in the two-way fixed effects model bear negative weights. To address this issue we compute the weights derived in de Chaisemartin and d'Haultfoeuille (2020) and find that 16 percent of our 862 weights are negative, and have a total weight of -0.054 (Table 4). Reassuringly, we compute the minimum standard deviation in the treatment effect across all district-month cells which would be required for the average ATT over all cells to in fact be zero, and find that the required amount of heterogeneity is implausibly large.[17] As shown in Table 4, the minimum standard deviation required is 0.0307 (Column 5). The pre-treatment

[16]Note that the concern about treatment effect heterogeneity raised by Goodman-Bacon (2018) and de Chaisemartin and d'Haultfoeuille (2020) applies to treatment effect heterogeneity between cells defined here by district and month/year, not between individuals *within* district-time cells differing, e.g., by predicted place of birth or other individual characteristics.

[17]We compute both the weights and the minimum standard deviation using de Chaisemartin and d'Haultfoeuille (2020)'s *twowayfeweights* command.

NMR incidence in the predicted home-birth sample is 5 percent or 0.05. If the (absolute values of the) ATTs for our 862 cells were drawn from a uniform distribution between 0 (no effect) and 0.05 (total eradication of NMR), the standard deviation (SD) would only be 0.014. If they were drawn instead from a normal distribution with mean 0.028 (our two-way fixed-effects estimate) and SD 0.0307 — the minimum SD required for the average ATT over all cells to be zero, we would have 40 percent of ATTs to be outside the [0,0.05] range, which is not plausible. In addition, after dropping the 140 cells with negative weights, the estimated effect of CHX application is almost identical (-0.029). In this new sample, the weights change and 7 percent of cells now have negative weights. After five iterations of dropping cells with negative weights and re-estimating both our two-way fixed effects model and the remaining cells weights, we obtain a sample with no negative weights and the treatment effect on the remaining cells is -0.026, compared to -0.028 in the full sample, demonstrating that our results are not driven by the negative weighting of some treatment effects.

[Table 4 about here.]

We also estimated a number of alternative specifications for Equation (1) and found no notable difference in estimates. In these alternative specifications, we removed all controls other than district and time effects, varied the subsets of controls included, added controls for additional health and nutritional programs, *in-utero* exposure to the severe earthquake which took place in 2015, controlled for an interaction term between baseline district neonatal mortality and a linear trend in month-year date of birth, and varied the sample in two ways: (i) changing the time period covered by the data — adding and removing five year cohorts on either side of our baseline 25-year panel — and (ii) removing or not children for whom the district of birth cannot be established with certainty because their mothers were currently visiting the household surveyed or because the woman had moved to the district where she was interviewed after the CHX program was first introduced in the country. As depicted in Figure 5, the estimated treatment effect for predicted home deliveries is consistently between -0.022 and -0.030 across specifications.[18]

[18]Similarly, for children predicted to be born in a health facility, our estimates are consistently

Our findings are also robust to adopting an alternative definition of neonatal mortality which is equal to zero for children reported to have died at exactly one month old and which are counted as having died within the neonatal period in the main analysis to allow for heaping (Appendix Table A.8). Weighted least squares estimates using the sampling weights provided by the DHS also lead to the same conclusions (Appendix Table A.9).

Finally, we fitted a logistic model to reflect the binary nature of our dependent variable of interest. The estimated treatment effects are, again, similar to our main specification despite being larger in magnitude and less precisely estimated (Appendix Table A.10).

Our results show clear evidence of beneficial effects of CHX-NCP on children predicted to being born at home, and no evidence of such benefits, on average, among other births. In the next section, we investigate further the question of which babies should be targeted by CHX cord care programs.

[Figure 5 about here.]

5 Treatment Effect Heterogeneity and Lessons for Targeting

Other than the lack of evidence supporting the efficacy of CHX in trials where most births take place in health facilities, a rationale for the WHO's recommendation of only applying CHX to the cord of babies born at home (in high-mortality settings) is that home deliveries are more likely to be associated with risk factors such as lack of a clean delivery kit, inappropriate hand washing practices and the application of harmful substances to the umbilical stump.

Our results confirm that, on average, children only significantly benefit from CHX application if they are predicted to be born at home. An important advantage of targeting births by place of delivery is the ease with which targeting can be effected. But would it be possible to improve targeting if some basic information about the mother and child were available? The type of risk factors associated with

between -0.003 and 0.007 across the same specifications (see Appendix Figure A.2).

home deliveries may indeed be associated with other observable characteristics, so that babies with these characteristics may benefit from CHX cord care irrespective of place of birth. In addition, omphalitis is more common among babies with other risk factors for neonatal mortality such as low birth weight (Painter and Feldman, 2019), so that these babies may benefit from CHX cord application irrespective of place of birth.

We therefore explore two hypotheses in our heterogeneity analysis. First, we test whether babies with characteristics which individually predict delivery at home benefit more from CHX application. Second, we investigate whether babies exposed to a higher risk of neonatal mortality would benefit more from CHX application.

Higher birth-order babies, babies born in more mountainous areas, in rural areas, and those born to less educated, poorer, Dalit and indigenous ("Janajati") mothers are significantly more likely to be delivered at home (see Appendix Table A.2). While babies with a combination of these characteristics are found to be more likely to be born at home and hence to benefit more from CHX-NCP, it is not clear whether any of these characteristics individually accounts for a larger effect of CHX-NCP. For each group broadly defined by each of these characteristics, we allow the effect of CHX to differ for this group relative to the rest of the sample, both conditional on predicted home- (Table 5) and institutional (Table 6) delivery (columns (3) to (8)).

We also test whether the effect of the CHX program is larger for babies at higher risk of neonatal death due to characteristics that are not individually significantly predictive of place of delivery. More specifically, in Tables 5 (predicted home births) and 6 (predicted institutional births), we estimate Equation 1 augmented by an interaction term between CHX-NCP and, in turn: being a first-born (Column (1)) and having a teenage mother (Column (2)).

Among predicted home deliveries, only the children of the 81 percent of mothers among this sample who have no formal education (Table 1) benefit significantly more from CHX application (Column (3) in Table 5). Although the estimated effect of the CHX program is not statistically significant for the 19 percent of babies whose mothers have at least some education, it is not the case that the CHX applica-

tion reduces NMR among predicted home births simply due to the higher proportion of women with no education among the mothers of children in the home-delivery sample. Indeed, in the sample of babies predicted to be delivered in a facility, there is no evidence that the CHX program reduces NMR among women with no education (Table 6, Column (3)). No other interaction term has a significant effect on neonatal mortality in the sample of children predicted to be delivered at home, although some of them are large in magnitude and suggest that the CHX program may be especially beneficial for first-borns and children of teenage mothers.

Among predicted facility deliveries, the total effect of CHX-NCP is statistically insignificant for all the categories we consider, although in the case of children of mothers aged 15 to 19, the total effect is large in magnitude (1.4 percentage points). When interacting the CHX dummy instead with an indicator for having a mother aged as young as 15 or 16 — while also controlling for an indicator for having a mother aged 15 or 16 to capture differences in outcomes among untreated babies — we find a very large (-8.3 percentage points) and statistically significant effect of CHX when the mother is aged 15 or 16. Given the small size of this subsample (360 control and 40 treated observations), we take these as suggestive rather than conclusive evidence of potential benefits for very young mothers among institutional deliveries as well (see Appendix Table A.11).

[Table 5 about here.]

[Table 6 about here.]

All in all, the heterogeneity analyses suggest that using place of delivery as a way to target those neonates who stand to benefit the most from CHX is both an expedient and effective approach, although a number of babies born in health facilities to young mothers would still be likely to benefit from CHX.

6 Conclusion

Neonatal mortality is an increasingly large contributor to early life mortality across the world, accounting for 45% of under-5 deaths in 2015 compared to 35%

in 1980 (Wang et al., 2016). While more efforts and resources than ever before are being targeted at reducing neonatal mortality (Shiffman, 2010) and most neonatal deaths are believed to be preventable at comparatively low cost (Bhutta et al., 2014), there is a wide gap between recommended- and actual practices in low-income countries (Friberg et al., 2010; Requejo et al., 2015). This is the case of CHX cord care, for which heterogeneous findings across randomized trials have led experts to question its effectiveness at scale.

In this paper, we estimate the effect of implementing a nationwide program training health personnel including community health workers to apply CHX to the umbilical stump and to distribute a single CHX dose to mothers who plan to deliver their baby at home. We find that the program led to a large reduction in neonatal mortality (43 percent), driven by reduced neonatal mortality among babies predicted to have been born at home. This provides the first evidence of the effectiveness of chlorhexidine cord care outside an experimental setting, and one of the rare instances of any successful nationwide intervention targeting neonatal mortality in a low-income country. We also show, for the first time within the same setting, that chlorhexidine cord care is only effective, on average, among births predicted to take place at home, therefore providing support to the World Health Organization's current recommendation of only preferring chlorhexidine- to dry cord care for home deliveries (in high-mortality settings). We nevertheless find suggestive evidence that chlorhexidine cord care is likely to be beneficial when mothers are very young — even when the baby is delivered in a health facility.

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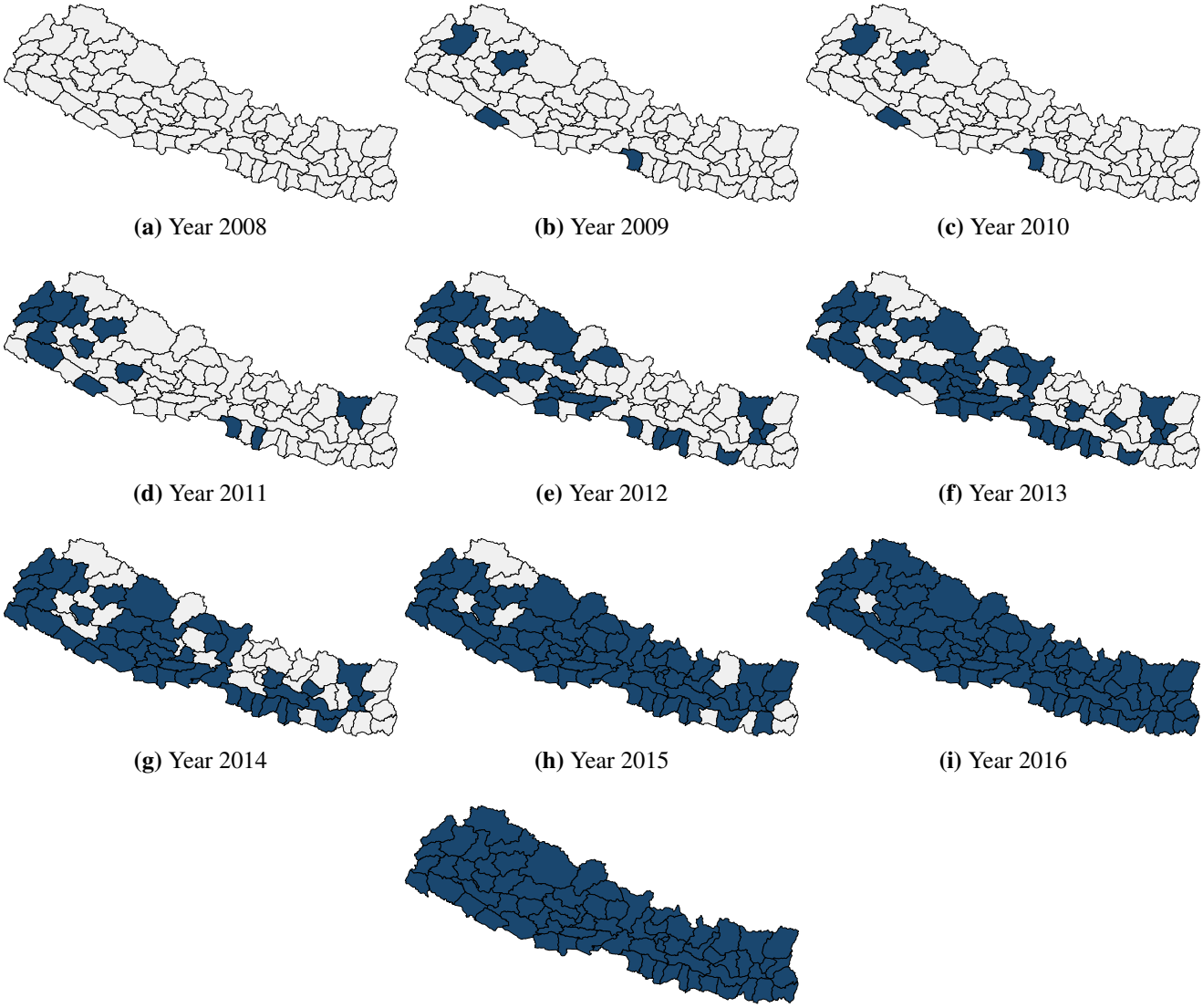
7 Figures & Tables



(a) Year 2008 **(b)** Year 2009 **(c)** Year 2010

(d) Year 2011 **(e)** Year 2012 **(f)** Year 2013

(g) Year 2014 **(h)** Year 2015 **(i)** Year 2016

(j) Year 2017

Figure 1: CHX cord application roll-out across districts over time (adopted CHX=blue).

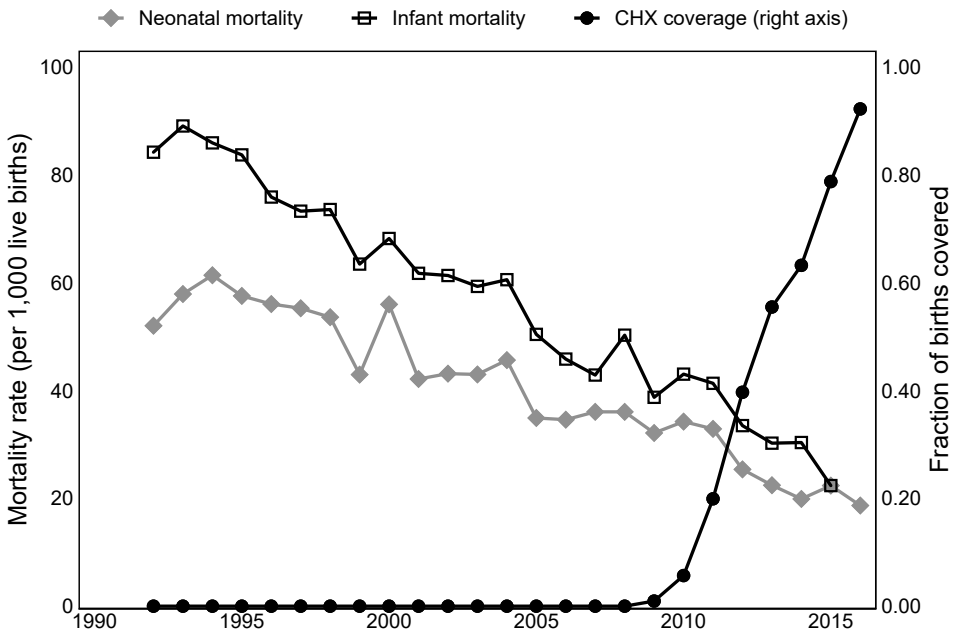


Figure 2: Child mortality and CHX-NCP coverage
Source: Own calculation based on DHS 2016 merged to administrative records on the roll-out of CHX-NCP.

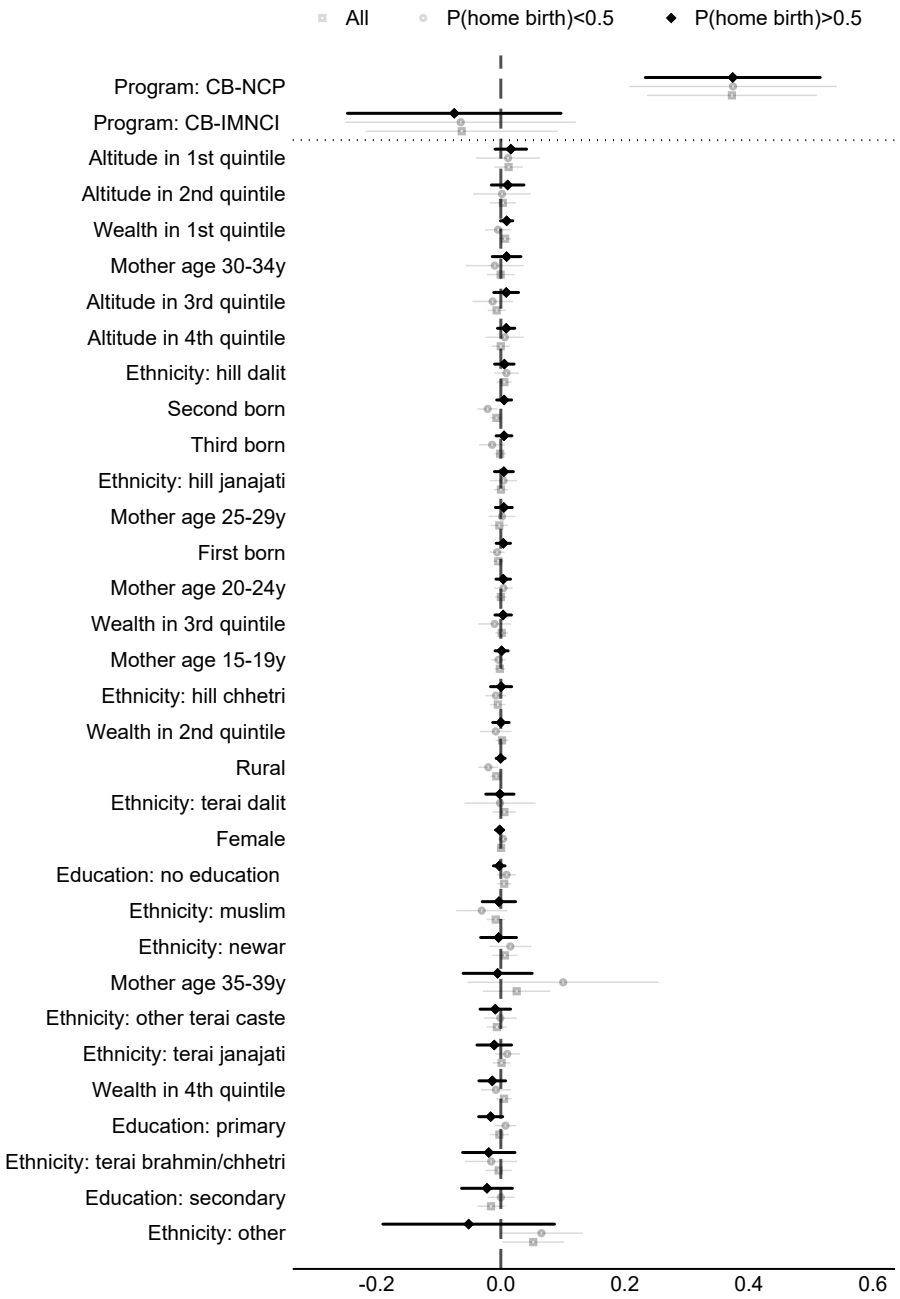


Figure 3: Covariate balance

Notes: This chart shows the beta coefficients and the 95 percent CI from running a regression with the treatment indicator as the dependent variable and each of the covariates listed in the figure, in turn as independent variables, as well as district and month of birth fixed effects. The confidence intervals are calculated based on standard errors obtained through 200 bootstrap iterations clustered at the district level. We split the sample according to the predicted place of delivery, based on the linear probability model shown in Appendix Table A.2. Appendix Table A.3 reports all coefficients.

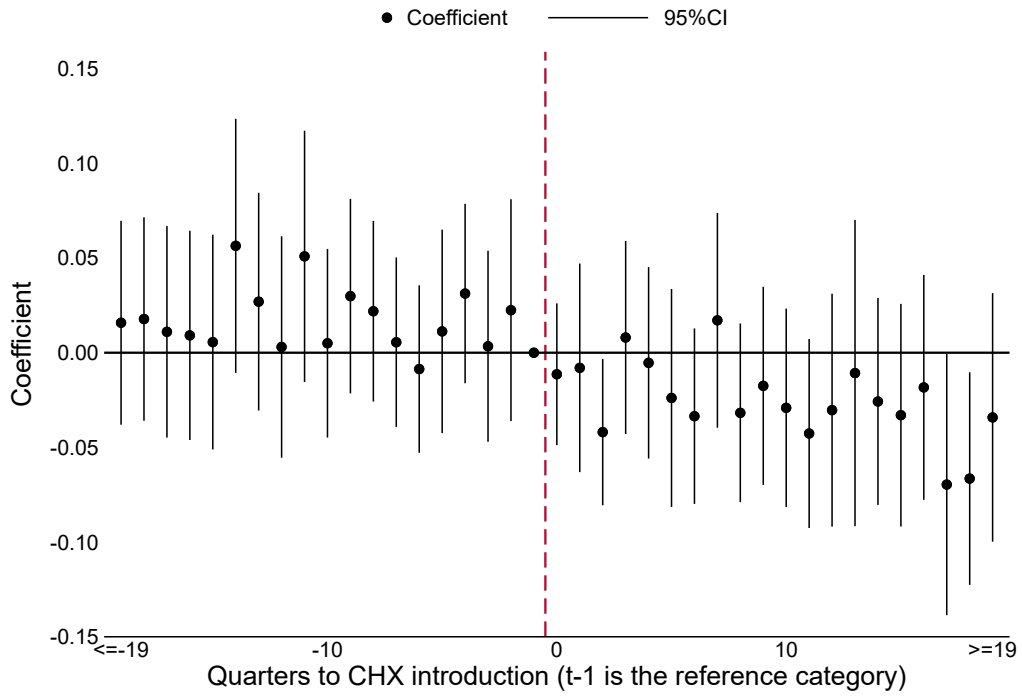


Figure 4: Event study chart.
Notes: Estimated on the sample: P(home birth)>0.5, with the full set of demographic, SES and program controls, as well as month of birth and district fixed effects. The confidence intervals are calculated based on standard errors obtained through 200 bootstrap iterations clustered at the district level. The place of delivery is predicted using the linear probability shown in Appendix Table A.2.

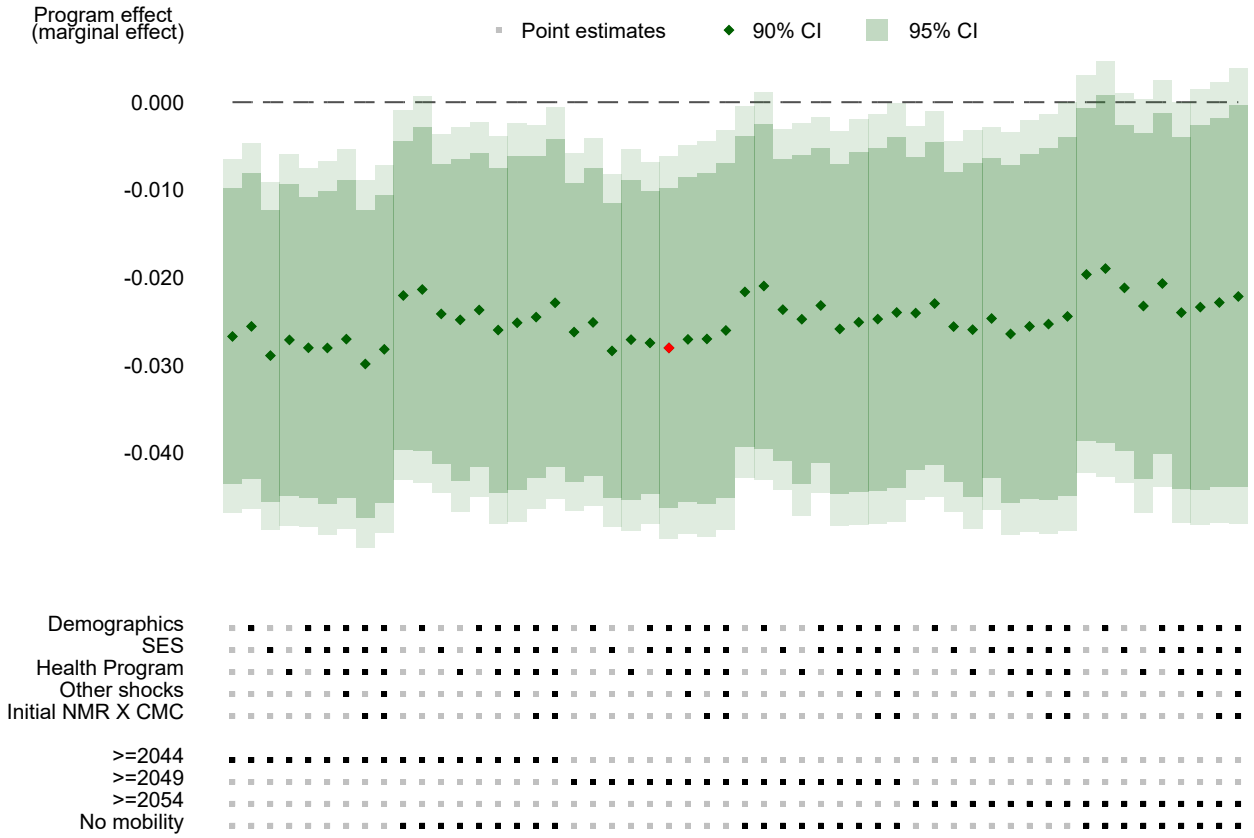


Figure 5: Specification Curve for predicted home births

Notes: This chart shows estimates from running 54 different specifications defined by the combination of markers bellow the chart. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. Other shocks refer to the earthquake on 25 April 2015, the Community Action for Nutrition Project, an Integrated Nutrition Program, and the Safe Delivery Incentive Program. Initial NMR $\times$ CMC is the initial neonatal mortality times a quadratic time trend. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. The confidence intervals are based on 200 bootstrap iterations clustered at the district level.

Table 1: Variable means

	All	P(Home Birth) <0.5	P(Home Birth) > 0.5
A. Demographics and SES			
Female	0.48	0.47	0.50
First born	0.34	0.53	0.14
Second born	0.28	0.29	0.27
Third born	0.18	0.11	0.25
Parity four or higher	0.21	0.07	0.34
Mother age 15-19y	0.20	0.26	0.13
Mother age 20-24y	0.41	0.46	0.37
Mother age 25-29y	0.26	0.21	0.32
Mother age 30-34y	0.10	0.07	0.13
Mother age 35-39y	0.03	0.01	0.04
Mother age 40-45y	0.01	0.00	0.01
Ethnicity Dalit	0.15	0.12	0.19
Rural	0.41	0.22	0.60
Education: no education	0.57	0.33	0.81
Education: primary	0.18	0.22	0.14
Education: secondary	0.19	0.34	0.04
Education: higher	0.06	0.11	0.01
Wealth in 1st quintile	0.27	0.07	0.48
Wealth in 2nd quintile	0.22	0.16	0.28
Wealth in 3rd quintile	0.20	0.25	0.15
Wealth in 4th quintile	0.17	0.27	0.07
Wealth in 5th quintile	0.13	0.25	0.01
B. Health programs			
Program: CB-NCP	0.16	0.18	0.13
Program: CB-IMNCI	0.05	0.07	0.03
Program: CHX	0.13	0.15	0.11
C. Child mortality			
Child died $\leq$1m	0.04	0.03	0.05
Child died <1m	0.03	0.03	0.04
Child died $\leq$12m	0.06	0.04	0.07
Child died $\leq$12m & >1m	0.01	0.01	0.02
Observations	23,465	11,719	11,746

Notes: Column two shows means for variables based on the full analysis sample. In columns three and four we split the sample according to the predicted place of delivery, based on the linear probability model shown in Appendix Table A.2.

Table 2: Regression results: The effect of CHX-NCP on neonatal mortality - Dependent variable: Mortality by $\leq$1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.018**	-0.007	0.001	-0.028**
	(0.007)	(0.007)	(0.009)	(0.011)
1[P(home birth)>0.5]		-0.001		
		(0.005)		
CHX × 1[P(home birth)>0.5]		-0.021***		
		(0.008)		
CHX + CHX × 1[P(home birth)>0.5]		-0.028***		
		(0.008)		
Observations	23,465	23,465	10,860	12,605
Clusters	73	73	73	73
Control mean of dep. var	0.042	0.042	0.033	0.050
P-val (dif across sample)				0.031

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All coefficients are reported in Appendix Table A.4. All specifications are estimated with district and month of birth fixed effects. We split the sample according to the predicted place of delivery, based on the linear probability model shown in Appendix Table A.2. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels: * p<0.1, ** p<0.05, and *** p<0.01.

Table 3: Regression results: placebo treatment, mother fixed effects, infant mortality. Sample: P(home birth)>0.5

	Placebo	Mother FE	Mortality	
			>1m&≤12m	≤12m
	(1)	(2)	(3)	(4)
CHX	-0.029**	-0.032**	0.015**	-0.016
	(0.012)	(0.016)	(0.006)	(0.014)
CHX_{t-12}	0.001			
	(0.013)			
Observations	12,605	11,654	12,373	12,373
Clusters	73	73	73	73
Control mean of dep. var	0.050	0.050	0.018	0.068

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls on the sample with P(home birth)>0.5. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table 4: Assessing the role of negative weights in the two-way fixed effects estimator.

	Coefficient	N_w	$N_{w<0}$	$\sum_{w<0} w$	σ_{FE}
	(1)	(2)	(3)	(4)	(5)
Baseline	-0.028**	862	140	-0.053974	0.0307
	(0.011)				
Iteration 1	-0.029***	662	46	-0.008862	0.0394
	(0.010)				
Iteration 2	-0.028***	600	12	-0.000816	0.0419
	(0.010)				
Iteration 3	-0.027**	582	8	-0.000241	0.0425
	(0.011)				
Iteration 4	-0.026**	570	4	-0.000034	0.0415
	(0.011)				
Iteration 5	-0.026**	565	0	0.000000	NA
	(0.011)				

Notes: All models are estimated on the sample: P(home birth)>0.5, with the full set of demographic, SES, and program controls as well as district and month of birth fixed effects. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table 5: Heterogeneity conditional on predicted home birth (sample: $P(homebirth) > 0.5$). Dependent variable: mortality $\leq 1m$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Program: CHX	-0.025**	-0.027**	-0.010	-0.033***	-0.024*	-0.024*	-0.034***	-0.029***
	(0.011)	(0.011)	(0.013)	(0.012)	(0.013)	(0.014)	(0.012)	(0.011)
First born	-0.001	-0.003	-0.003	-0.003	-0.003	0.014**	-0.003	-0.003
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.009)	(0.009)
Mother age 15-19y	0.023	0.023	0.021	0.023	0.022	0.016	0.023	0.023
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.027)	(0.026)	(0.026)
Education: no education	0.042***	0.042***	0.046***	0.042***	0.042***	0.042***	0.042***	0.042***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Wealth in 1st quintile	0.019	0.019	0.018	0.019	0.019	0.019	0.019	0.020
	(0.020)	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)
Rural	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001	-0.000	-0.000
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
CHX × First born	-0.021							
	(0.019)							
CHX × Mother age 15-19y		-0.011						
		(0.021)						
CHX × Education: no education			-0.028***					
			(0.010)					
CHX × Wealth in 1st quintile				0.010				
				(0.009)				
CHX × Rural					-0.007			
					(0.011)			
CHX × Parity ≥ 3						-0.007		
						(0.009)		
CHX × Altitude $\geq$ 4q							0.011	
							(0.011)	
CHX × Ethn [t. dalit/h. janajati]								0.003
								(0.011)
Interaction+Level	-0.046**	-0.037	-0.039***	-0.023*	-0.031***	-0.031***	-0.023*	-0.026*
	(0.022)	(0.024)	(0.011)	(0.013)	(0.012)	(0.010)	(0.013)	(0.014)

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table 6: Heterogeneity conditional on predicted facility births (sample: $P(homebirth) < 0.5$). Dependent variable: mortality $\leq 1m$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Program: CHX	0.004	0.006	0.000	-0.000	0.002	-0.001	-0.001	-0.001
	(0.011)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
First born	0.012	0.011	0.011	0.012	0.011	0.008*	0.012	0.011
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.005)	(0.009)	(0.009)
Mother age 15-19y	0.036**	0.040**	0.036**	0.035**	0.034**	0.037**	0.032*	0.034**
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Education: no education	0.023***	0.023***	0.022***	0.023***	0.023***	0.023***	0.023***	0.023***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Wealth in 1st quintile	0.012	0.012	0.012	0.009	0.011	0.011	0.013	0.013
	(0.011)	(0.011)	(0.011)	(0.014)	(0.011)	(0.011)	(0.011)	(0.011)
Rural	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
CHX × First born	-0.005							
	(0.009)							
CHX × Mother age 15-19y		-0.020*						
		(0.012)						
CHX × Education: no education			0.006					
			(0.015)					
CHX × Wealth in 1st quintile				0.011				
				(0.022)				
CHX × Rural					-0.001			
					(0.011)			
CHX × Parity ≥ 3						0.014		
						(0.011)		
CHX × Altitude $\geq$ 4q							0.006	
							(0.011)	
CHX × Ethn [t. dalit/h. janajati]								0.012
								(0.012)
Interaction+Level	-0.001	-0.014	0.006	0.011	0.000	0.013	0.005	0.011
	(0.009)	(0.013)	(0.017)	(0.023)	(0.013)	(0.014)	(0.012)	(0.014)

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

A Appendix (for Online Publication Only)

Table A.1: Effect of CHX-NCP on Home delivery and Antenatal Care

	(1)	(2)	(3)	(4)
A. Dependent variable: home delivery (binary; mean: 0.41)				
Program: CHX	-0.020	-0.014	-0.028	-0.032
	(0.027)	(0.024)	(0.024)	(0.025)
Observations	4955	4955	4955	4955
B. Dependent variable: antenatal visits (count; mean: 4.23)				
Program: CHX	0.001	-0.028	0.052	0.071
	(0.141)	(0.133)	(0.117)	(0.109)
Observations	3966	3966	3966	3966
C. Dependent variable: antenatal visits above median (binary; mean: 0.37)				
Program: CHX	-0.012	-0.016	-0.004	0.001
	(0.030)	(0.029)	(0.029)	(0.030)
Observations	3966	3966	3966	3966
DEM controls	No	Yes	Yes	Yes
SES controls	No	No	Yes	Yes
Program controls	No	No	No	Yes

Notes: All specifications are estimated as linear probability models using OLS with district and month of birth fixed effects. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * $p<0.1$, ** $p<0.05$, and *** $p<0.01$.

Table A.2: Predicting home deliveries

	Logit (1)	LPM (2)
Female	0.004	0.006
	(0.012)	(0.012)
First born	-0.248***	-0.267***
	(0.026)	(0.027)
Second born	-0.090***	-0.112***
	(0.019)	(0.022)
Third born	-0.022	-0.029
	(0.017)	(0.019)
Mother age 15-19y	0.069	0.067
	(0.062)	(0.065)
Mother age 20-24y	0.034	0.039
	(0.059)	(0.063)
Mother age 25-29y	0.015	0.018
	(0.057)	(0.062)
Mother age 30-34y	-0.048	-0.046
	(0.059)	(0.064)
Mother age 35-39y	-0.040	-0.048
	(0.060)	(0.064)
Ethnicity: hill chhetri	0.042	0.031
	(0.039)	(0.032)
Ethnicity: terai brahmin/chhetri	-0.091	-0.126**
	(0.066)	(0.055)
Ethnicity: other terai caste	0.065	0.040
	(0.047)	(0.045)
Ethnicity: hill dalit	0.053	0.034
	(0.046)	(0.043)
Ethnicity: terai dalit	0.095*	0.092*
	(0.050)	(0.048)
Ethnicity: newar	0.057	0.044
	(0.056)	(0.043)
Ethnicity: hill janajati	0.112***	0.099***
	(0.039)	(0.033)
Ethnicity: terai janajati	0.031	-0.000
	(0.047)	(0.038)
Ethnicity: muslim	0.063	0.027
	(0.050)	(0.048)
Ethnicity: other	-0.000	0.071
	(0.137)	(0.066)
Rural	0.120***	0.130***
	(0.025)	(0.029)
Altitude in 1st quintile	-0.139*	-0.108

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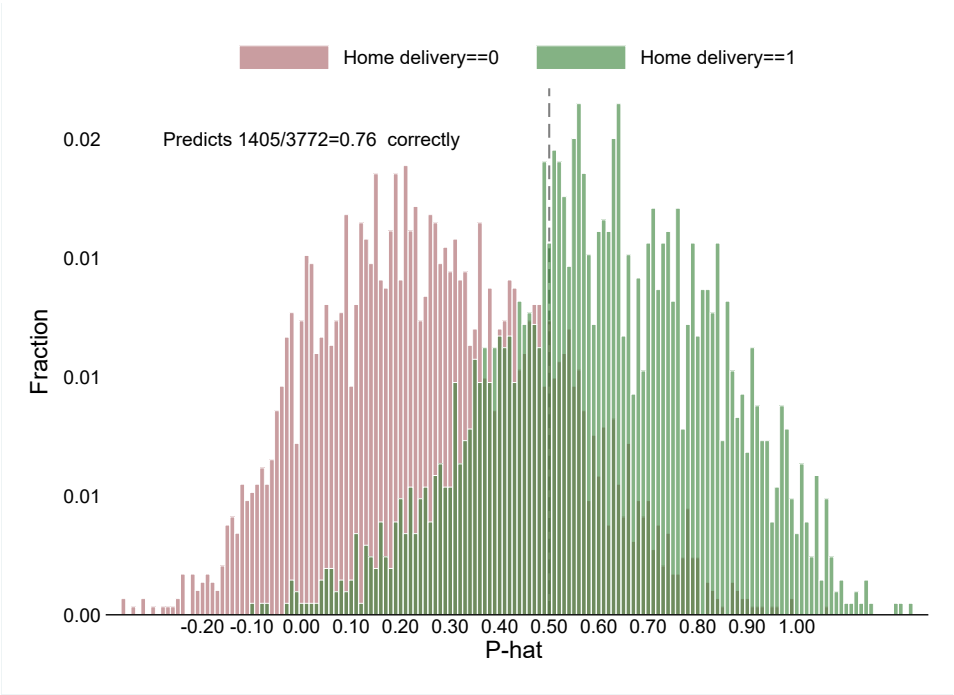
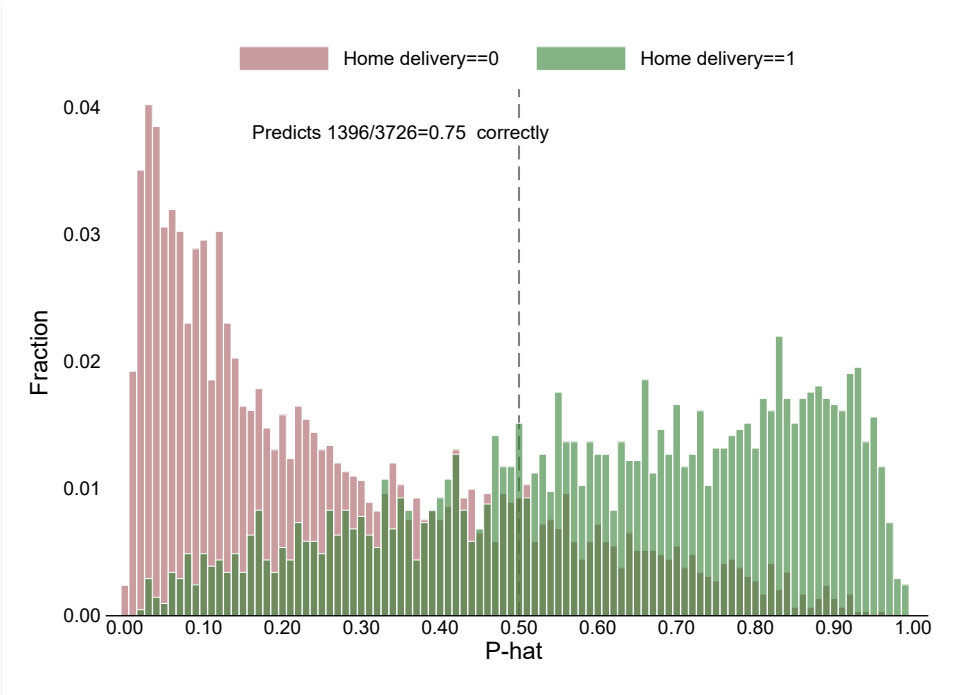
	Logit (1)	LPM (2)
	(0.071)	(0.077)
Altitude in 2nd quintile	-0.167**	-0.141*
	(0.074)	(0.081)
Altitude in 3rd quintile	-0.114**	-0.093
	(0.056)	(0.064)
Altitude in 4th quintile	0.014	0.012
	(0.048)	(0.054)
Education: no education	0.146***	0.137***
	(0.030)	(0.027)
Education: primary	0.104***	0.082***
	(0.030)	(0.026)
Education: secondary	0.071***	0.035*
	(0.027)	(0.020)
Wealth in 1st quintile	0.288***	0.278***
	(0.034)	(0.033)
Wealth in 2nd quintile	0.235***	0.208***
	(0.032)	(0.029)
Wealth in 3rd quintile	0.119***	0.084***
	(0.030)	(0.027)
Wealth in 4th quintile	0.090***	0.051*
	(0.032)	(0.026)
Observations	4,956	4,956
P(home birth)>0.5|Home birth==1	1396	1405
P(home birth)<0.5|Home birth==0	2330	2367
P(home birth)>0.5|Home birth==0	545	543
P(home birth)<0.5|Home birth==1	640	641
Correct predictions (share)	0.752	0.761

Notes: Column (1) shows average marginal effects from estimating a Logit specification. Column (2) shows point estimates from estimating a linear probability models. Both regressions include district fixed effects and date of birth, defined by Nepali month and year of birth, fixed effects. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.



(a) LPM



(b) LOGIT

Figure A.1: Distribution of predicted probabilities for home births, by actual home birth (see Table A.2 for details).

Table A.3: Balancing table. Dependent variable: CHX.

	All	P(home birth)	
		<0.5	>0.5
	(1)	(2)	(3)
Female	0.000	0.003	-0.002
	(0.002)	(0.003)	(0.003)
Second born	-0.004	-0.006	0.004
	(0.004)	(0.006)	(0.006)
Third born	-0.007	-0.021***	0.005
	(0.005)	(0.008)	(0.006)
Parity four or higher	-0.001	-0.014	0.005
	(0.005)	(0.010)	(0.007)
Mother age 20-24y	-0.002	-0.004	0.001
	(0.004)	(0.005)	(0.005)
Mother age 25-29y	0.000	0.004	0.004
	(0.004)	(0.007)	(0.006)
Mother age 30-34y	-0.002	0.002	0.005
	(0.007)	(0.011)	(0.007)
Mother age 35-39y	-0.000	-0.010	0.009
	(0.011)	(0.024)	(0.012)
Mother age 40-45y	0.026	0.101	-0.005
	(0.027)	(0.078)	(0.028)
Ethnicity: hill chhetri	-0.005	-0.008	0.000
	(0.006)	(0.008)	(0.009)
Ethnicity: terai brahmin/chhetri	-0.003	-0.016	-0.019
	(0.010)	(0.021)	(0.022)
Ethnicity: other terai caste	-0.006	-0.001	-0.009
	(0.008)	(0.013)	(0.013)
Ethnicity: hill dalit	0.006	0.009	0.006
	(0.006)	(0.010)	(0.008)
Ethnicity: terai dalit	0.006	-0.001	-0.001
	(0.009)	(0.029)	(0.012)
Ethnicity: newar	0.007	0.015	-0.004
	(0.010)	(0.017)	(0.015)
Ethnicity: hill janajati	0.000	0.004	0.005
	(0.006)	(0.011)	(0.008)
Ethnicity: terai janajati	0.001	0.010	-0.011
	(0.007)	(0.010)	(0.014)
Ethnicity: muslim	-0.008	-0.031	-0.003
	(0.007)	(0.021)	(0.014)
Ethnicity: other	0.052**	0.066**	-0.052
	(0.025)	(0.033)	(0.071)
Rural	-0.007*	-0.020**	-0.000
	(0.004)	(0.008)	(0.004)

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	All	P(home birth)	
		<0.5	>0.5
	(1)	(2)	(3)
Altitude in 1st quintile	0.013	0.012	0.016
	(0.011)	(0.026)	(0.013)
Altitude in 2nd quintile	0.003	0.002	0.011
	(0.010)	(0.023)	(0.013)
Altitude in 3rd quintile	-0.007	-0.013	0.009
	(0.007)	(0.016)	(0.010)
Altitude in 4th quintile	-0.000	0.006	0.009
	(0.007)	(0.015)	(0.007)
Education: primary	0.005	0.009	-0.003
	(0.005)	(0.007)	(0.005)
Education: secondary	-0.002	0.008	-0.016*
	(0.007)	(0.009)	(0.010)
Education: higher	-0.016	0.000	-0.022
	(0.011)	(0.011)	(0.021)
Wealth in 2nd quintile	0.007	-0.004	0.009*
	(0.004)	(0.010)	(0.005)
Wealth in 3rd quintile	0.002	-0.008	0.000
	(0.005)	(0.013)	(0.007)
Wealth in 4th quintile	0.001	-0.010	0.004
	(0.005)	(0.013)	(0.007)
Wealth in 5th quintile	0.005	-0.008	-0.014
	(0.006)	(0.012)	(0.011)
Program: CB-NCP	0.373***	0.374***	0.374***
	(0.069)	(0.085)	(0.072)
Program: CB-IMNCI	-0.063	-0.065	-0.075
	(0.079)	(0.094)	(0.088)
Constant	0.082***	0.108***	0.049**
	(0.019)	(0.033)	(0.019)
Observations	23465	23465	23465

Notes: All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.4: Regression results: The effect of CHX-NCP on neonatal mortality - Dependent variable: Mortality by $\leq$1m. Reporting all coefficient estimates

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
Female	-0.014***	-0.014***	-0.007*	-0.021***
	(0.003)	(0.003)	(0.004)	(0.005)
First born	0.003	0.001	0.011	-0.003
	(0.005)	(0.005)	(0.009)	(0.009)
Second born	-0.007	-0.008*	0.004	-0.016**
	(0.005)	(0.005)	(0.010)	(0.007)
Third born	-0.008*	-0.008*	-0.002	-0.010
	(0.005)	(0.005)	(0.008)	(0.006)
Mother age 15-19y	0.019	0.019	0.034**	0.022
	(0.022)	(0.022)	(0.017)	(0.026)
Mother age 20-24y	-0.003	-0.003	0.015	-0.005
	(0.020)	(0.020)	(0.016)	(0.024)
Mother age 25-29y	-0.011	-0.011	0.011	-0.017
	(0.021)	(0.020)	(0.017)	(0.024)
Mother age 30-34y	-0.008	-0.008	0.019	-0.017
	(0.021)	(0.021)	(0.017)	(0.027)
Mother age 35-39y	-0.006	-0.006	0.017	-0.013
	(0.022)	(0.022)	(0.020)	(0.026)
Ethnicity: hill chhetri	-0.005	-0.005	-0.000	-0.016
	(0.005)	(0.005)	(0.005)	(0.012)
Ethnicity: terai brahmin/chhetri	0.002	0.002	0.009	-0.010
	(0.015)	(0.015)	(0.016)	(0.036)
Ethnicity: other terai caste	0.002	0.002	0.006	-0.012
	(0.009)	(0.009)	(0.012)	(0.018)
Ethnicity: hill dalit	-0.004	-0.004	-0.006	-0.010
	(0.006)	(0.006)	(0.007)	(0.013)
Ethnicity: terai dalit	0.019	0.019	0.002	0.008
	(0.012)	(0.012)	(0.018)	(0.018)
Ethnicity: newar	0.003	0.003	0.001	-0.002
	(0.009)	(0.009)	(0.011)	(0.022)
Ethnicity: hill janajati	-0.006	-0.005	-0.010	-0.009
	(0.006)	(0.006)	(0.007)	(0.013)
Ethnicity: terai janajati	0.007	0.006	0.016*	-0.022
	(0.007)	(0.007)	(0.009)	(0.014)
Ethnicity: muslim	-0.006	-0.006	0.002	-0.020
	(0.012)	(0.012)	(0.012)	(0.024)
Ethnicity: other	0.002	0.002	0.003	-0.005
	(0.023)	(0.023)	(0.051)	(0.076)

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	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
Rural	0.003	0.003	0.010	-0.001
	(0.003)	(0.004)	(0.006)	(0.005)
Altitude in 1st quintile	-0.014	-0.014	-0.026	-0.012
	(0.012)	(0.012)	(0.019)	(0.023)
Altitude in 2nd quintile	-0.026**	-0.026**	-0.028*	-0.032
	(0.011)	(0.011)	(0.016)	(0.022)
Altitude in 3rd quintile	-0.015*	-0.015*	-0.021	-0.013
	(0.008)	(0.008)	(0.015)	(0.011)
Altitude in 4th quintile	-0.007	-0.007	-0.017	-0.006
	(0.007)	(0.007)	(0.012)	(0.009)
Education: no education	0.018***	0.020***	0.023***	0.042***
	(0.005)	(0.005)	(0.006)	(0.013)
Education: primary	0.008*	0.010**	0.012**	0.033***
	(0.005)	(0.005)	(0.006)	(0.012)
Education: secondary	0.007	0.008*	0.005	0.039**
	(0.004)	(0.004)	(0.005)	(0.016)
Wealth in 1st quintile	0.017**	0.018**	0.011	0.019
	(0.007)	(0.008)	(0.011)	(0.019)
Wealth in 2nd quintile	0.019***	0.020***	0.019**	0.018
	(0.006)	(0.006)	(0.008)	(0.019)
Wealth in 3rd quintile	0.013***	0.013***	0.009	0.013
	(0.005)	(0.005)	(0.006)	(0.016)
Wealth in 4th quintile	0.004	0.004	-0.000	0.006
	(0.005)	(0.005)	(0.006)	(0.016)
Program: CB-NCP	0.006	0.005	0.006	-0.000
	(0.006)	(0.006)	(0.008)	(0.008)
Program: CB-IMNCI	-0.003	-0.003	0.002	-0.010
	(0.006)	(0.006)	(0.008)	(0.010)
CHX	-0.018**	-0.007	0.001	-0.028**
	(0.007)	(0.007)	(0.009)	(0.011)
1[P(home birth)>0.5]		-0.001		
		(0.005)		
CHX × 1[P(home birth)>0.5]		-0.021***		
		(0.008)		
CHX + CHX × 1[P(home birth)>0.5]		-0.028***		
		(0.008)		
Observations	23,465	23,465	10,860	12,605
Clusters	73	73	73	73
Control mean of dep. var	0.042	0.042	0.033	0.050
P-val (dif across sample)				0.031

Notes: All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.5: Placebo regression with 12m lead indicator and pre period only. - Dependent variable: Mortality by $\leq$1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.005	-0.007	-0.011	0.003
	(0.008)	(0.010)	(0.011)	(0.013)
1[P(home birth)>0.5]		-0.009		
		(0.006)		
CHX $\times$ 1[P(home birth)>0.5]		0.004		
		(0.013)		
CHX + CHX $\times$ 1[P(home birth)>0.5]		-0.003		
		(0.010)		
Observations	20,321	20,321	7,262	13,047
Clusters	73	73	73	73
Control mean of dep. var	0.043	0.043	0.032	0.049
P-val (dif across sample)				0.418

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.6: Regression results including only the first post treatment year. - Dependent variable: Mortality by $\leq$1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.015	-0.002	0.004	-0.027**
	(0.009)	(0.012)	(0.013)	(0.011)
1[P(home birth)>0.5]		-0.007		
		(0.005)		
CHX × 1[P(home birth)>0.5]		-0.025*		
		(0.013)		
CHX + CHX × 1[P(home birth)>0.5]		-0.027***		
		(0.009)		
Observations	21,185	21,185	9,050	12,129
Clusters	73	73	73	73
Control mean of dep. var	0.042	0.042	0.034	0.049
P-val (dif across sample)				0.060

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.7: Regression results: The effect of CHX-NCP on neonatal mortality. - Dependent variable: Mortality by $\leq$1m. Using actual place of delivery.

	Sample			
	All	All	Home birth	
			No	Yes
	(1)	(2)	(3)	(4)
Program: CHX	-0.003	0.007	0.007	-0.012
	(0.008)	(0.008)	(0.010)	(0.016)
CHX $\times$ Home Delivery		-0.023**		
		(0.011)		
Home Delivery		0.020**		
		(0.009)		
CHX + CHX $\times$ Home Delivery		-0.016		
P-val (CHX + CHX $\times$ Home Delivery=0)		0.148		
Observations	4,839	4,839	2,829	2,008
Clusters	73	73	71	70
Control mean of dep. var	0.025	0.025	0.013	0.041

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. All specifications are estimated with district and month of birth fixed effects. Bootstrapped standard errors based on 200 iterations and clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.8: Regression results - Dependent variable: Mortality by <1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.014**	-0.006	0.002	-0.022**
	(0.007)	(0.007)	(0.008)	(0.010)
1[P(home birth)>0.5]		-0.002		
		(0.005)		
CHX × 1[P(home birth)>0.5]		-0.016**		
		(0.008)		
CHX + CHX × 1[P(home birth)>0.5]		-0.022***		
		(0.008)		
Observations	23,552	23,552	10,920	12,631
Clusters	73	73	73	73
Control mean of dep. var	0.037	0.037	0.028	0.044
P-val (dif across sample)				0.057

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. All specifications are estimated with district and month of birth fixed effects. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.9: Regression results with survey weights: The effect of CHX-NCP on neonatal mortality. - Dependent variable: Mortality by $\leq$1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.017**	-0.004	0.001	-0.027**
	(0.007)	(0.008)	(0.010)	(0.012)
1[P(home birth)>0.5]		0.007		
		(0.006)		
CHX × 1[P(home birth)>0.5]		-0.025***		
		(0.009)		
CHX + CHX × 1[P(home birth)>0.5]		-0.029***		
		(0.009)		
Observations	23,465	23,465	10,966	12,498
Clusters	73	73	73	73
Control mean of dep. var	0.042	0.042	0.033	0.051
P-val (dif across sample)				0.084

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. All specifications are estimated with district and month of birth fixed effects. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

Table A.10: Regression results using a Logit specification: The effect of CHX-NCP on neonatal mortality. - Dependent variable: Mortality by $\leq$1m.

	Sample			
	All	All	P(home birth)	
			<0.5	>0.5
	(1)	(2)	(3)	(4)
CHX	-0.021*	-0.006	0.008	-0.053**
	(0.012)	(0.013)	(0.023)	(0.024)
1[P(home birth)>0.5]		-0.006		
		(0.006)		
CHX × 1[P(home birth)>0.5]		-0.029**		
		(0.014)		
CHX + CHX × 1[P(home birth)>0.5]		-0.035**		
		(0.015)		
Observations	21,750	21,613	6,778	10,846
Clusters	73	73	73	73
Control mean of dep. var	0.042	0.042	0.033	0.050
P-val (dif across sample)				0.048

Notes: Marginal effects. All specifications are estimated as logit models with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. We predict the place of delivery using the logit the specification shown in Appendix Table A.2. All specifications are estimated with district and month of birth fixed effects. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.

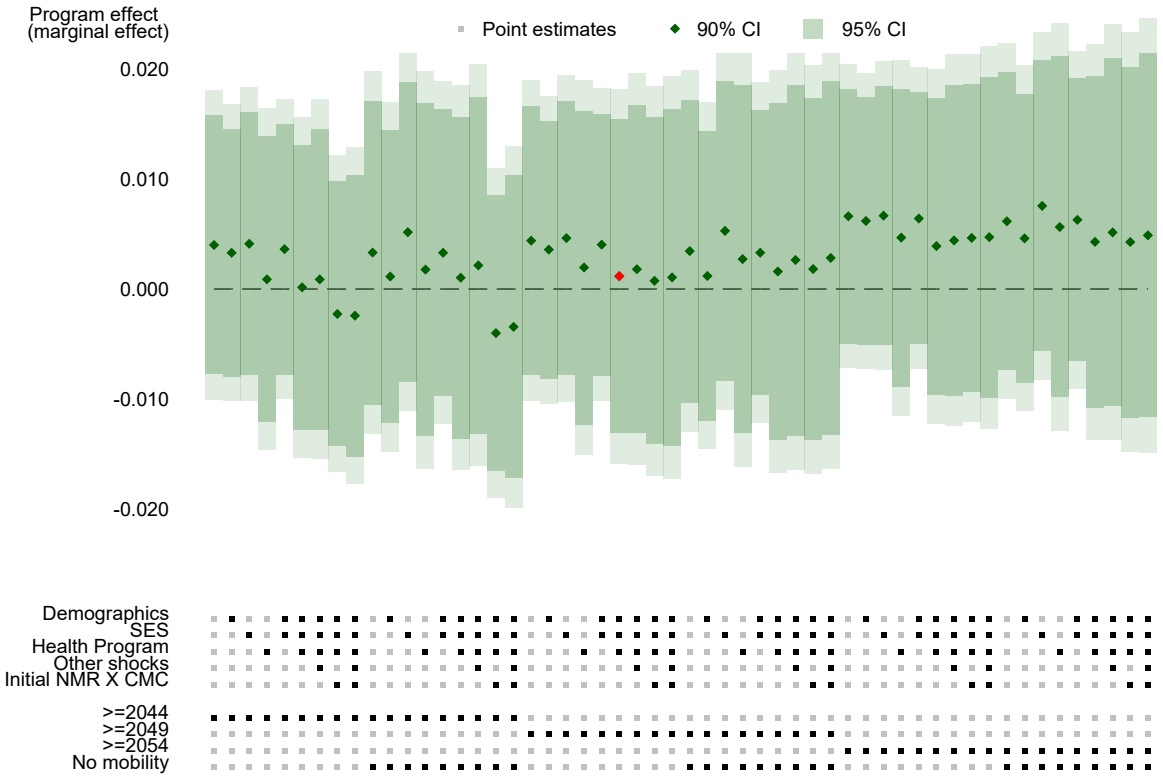

Figure A.2: Specification Curve for the sample P(home birth)<0.5

Notes: This chart shows estimates from running 128 different specifications defined by the combination of markers bellow the chart. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and a Dalit ethnicity indicator. Program controls include controls for the CB-NCP and CB-IMNCI health programs. Other shocks refer to the earthquake on 25 April 2015, the Community Action for Nutrition Project, an Integrated Nutrition Program, and the Safe Delivery Incentive Program. Initial NMR $\times$ CMC is the initial neonatal mortality times a quadratic time trend. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. The confidence intervals are based on 200 bootstrap iterations clustered at the district level.

Table A.11: Heterogeneity - very young mothers. Dependent variable: Mortality by $\leq$1m.

	Sample P(home birth)	
	<0.5	>0.5
	(1)	(2)
Program: CHX	0.004	-0.027**
	(0.009)	(0.011)
Mother 15-16y	0.076***	0.061
	(0.026)	(0.042)
Mother 15-16y × CHX	-0.086***	-0.044
	(0.026)	(0.059)
Interaction+Level	-0.083***	-0.071
	(0.026)	(0.061)
Observations	10,860	12,605
Clusters	73	73
Mean of dep. var.	0.042	0.050

Notes: All specifications are estimated as linear probability models using OLS with the full set of demographic, SES, and program controls. Demographic controls include birth order (three indicators), five year maternal age group indicators, and gender. SES controls include education (three indicators), wealth (four indicators), rural indicator, altitude quintile indicators, and ethnicity indicators. Program controls include controls for the CB-NCP and CB-IMNCI health programs. The place of delivery is predicted using the linear probability shown in Appendix Table A.2. All specifications are estimated with district and month of birth fixed effects. Bootstrapped standard errors clustered at the district level in parentheses. Asterisks indicate significance at the following levels * p<0.1, ** p<0.05, and *** p<0.01.